

CLAIMS

What is claimed is:

1. An electrode plate assembly for introducing process gas to a process space above a substrate in a plasma processing system comprising:
an electrode configured to be coupled to said plasma processing system;
three or more mounting screws coupled to said electrode;
an electrode plate comprising a plurality of gas injection holes, and
three or more mounting holes configured to be aligned with and coupled to said mounting screws in order to couple said electrode plate to said electrode;
and
a plurality of gas injection devices coupled to said plurality of gas injection holes, wherein said process gas passes through said plurality of gas injection devices into said process space.
2. The electrode plate assembly of claim 1, wherein each of said gas injection devices comprises a gas injection orifice.
3. The electrode plate assembly of claim 2, wherein each of said gas injection orifices is characterized by a diameter, a shape, and a length.
4. The electrode plate assembly of claim 3, wherein at least one of said diameter, shape, and length is varied for at least one gas injection orifice as compared to another of said gas injection orifices.
5. The electrode plate assembly of claim 4, wherein said variation facilitates an increase in the flow rate of said process gas to the center of said process space above said substrate relative to the flow of process gas to the edge of said process space.
6. The electrode plate assembly of claim 4, wherein said variation facilitates a decrease in the flow rate of said process gas to the center of said

process space above said substrate relative to the flow of process gas to the edge of said process space.

7. The electrode plate assembly of claim 1, wherein said electrode plate is made from at least one of aluminum, coated aluminum, silicon, quartz, silicon carbide, silicon nitride, carbon, alumina, sapphire, polyimide, and Teflon.

8. The electrode plate assembly of claim 1, wherein said plurality of gas injection devices is made from at least one of aluminum, coated aluminum, silicon, quartz, silicon carbide, silicon nitride, carbon, alumina, sapphire, polyimide, and Teflon.

9. The electrode plate assembly of claim 1, wherein said electrode is made from at least one of aluminum, coated aluminum, silicon, quartz, silicon carbide, silicon nitride, carbon, alumina, sapphire, polyimide, and Teflon.

10. The electrode plate assembly of claim 1, wherein each of said three or more mounting screws comprise a head region, and each of said three or more mounting holes comprise a slot recess having an insertion opening configured to pass said head region when aligning said electrode plate with said electrode and a recess lip configured to capture said head region when coupling said electrode plate to said electrode.

11. The electrode plate assembly of claim 7, wherein said electrode plate is made from said coated aluminum and the coating comprises at least one of surface anodization, a coating formed using plasma electrolytic oxidation, and a spray coating.

12. The electrode plate assembly of claim 8, wherein said plurality of gas injection devices are made from said coated aluminum and the coating comprises at least one of surface anodization, a coating formed using plasma electrolytic oxidation, and a spray coating.

13. The electrode plate assembly of claim 9, wherein said electrode is made from said coated aluminum and the coating comprises at least one of surface anodization, a coating formed using plasma electrolytic oxidation, and a spray coating.

14. The electrode plate assembly of claim 7, wherein said electrode plate is made from coated aluminum and the coating comprises at least one of a III-column element and a Lanthanum element.

15. The electrode plate assembly of claim 8, wherein said plurality of gas injection devices are made from coated aluminum and the coating comprises at least one of a III-column element and a Lanthanum element.

16. The electrode plate assembly of claim 9, wherein said electrode is made from coated aluminum and the coating comprises at least one of a III-column element and a Lanthanum element.

17. The electrode plate assembly of claim 7, wherein said electrode plate is made from coated aluminum and the coating comprises at least one of Al_2O_3 , Yttria (Y_2O_3), Sc_2O_3 , Sc_2F_3 , YF_3 , La_2O_3 , CeO_2 , Eu_2O_3 , and DyO_3 .

18. The electrode plate assembly of claim 8, wherein said plurality of gas injection devices are made from coated aluminum and the coating comprises at least one of Al_2O_3 , Yttria (Y_2O_3), Sc_2O_3 , Sc_2F_3 , YF_3 , La_2O_3 , CeO_2 , Eu_2O_3 , and DyO_3 .

19. The electrode plate assembly of claim 9, wherein said electrode is made from coated aluminum and the coating comprises at least one of Al_2O_3 , Yttria (Y_2O_3), Sc_2O_3 , Sc_2F_3 , YF_3 , La_2O_3 , CeO_2 , Eu_2O_3 , and DyO_3 .

20. A disposable electrode plate for introducing process gas to a process space above a substrate in a plasma processing system comprising:
an electrode plate comprising a plurality of gas injection holes, and
three or more mounting holes, wherein said electrode plate is configured to be

coupled with an electrode by aligning and coupling said three or more mounting holes with three or more mounting screws attached to said electrode; and

a plurality of gas injection devices coupled to said plurality of gas injection holes, wherein said process gas passes through said plurality of gas injection devices into said process space.

21. A method of replacing an electrode plate for introducing process gas to a process space above a substrate in a plasma processing system comprising:

removing a first electrode plate from said plasma processing system;
and

installing a second electrode plate in said plasma processing system,
wherein said first electrode plate and said second electrode plate each comprise a plurality of gas injection holes configured to receive gas injection devices, and three or more mounting holes, wherein each of said first electrode plate and said second electrode plate are configured to be coupled with an electrode in said plasma processing system by aligning and coupling said three or more mounting holes with three or more mounting screws attached to said electrode.

22. The method of claim 21, further comprising:

replacing said gas injection devices in said gas injection holes of said first electrode plate to create said second electrode plate.

23. The method of claims 21, wherein each of said three or more mounting screws comprise a head region, and each of said three or more mounting holes comprise a slot recess having an insertion opening configured to pass said head region when aligning said electrode plate with said electrode and a recess lip configured to capture said head region when coupling said electrode plate to said electrode, and said installing comprises rotating said second electrode plate relative to said electrode.